West Lake Landfill Superfund Site
Isolation Barrier Alternatives Analysis October 10, 2014
USACE Review Comments – submitted Nov 6, 2014

1) Section 3.4. If no action option is implemented and the SSE moved through the north quarry into Area 1, it is likely that the surface of the north quarry would drop and any leachate collection lines could potentially be severed due to the drop in landfill surface. If that occurred, would leachate spills from severed lines cause a potential increase in odors?

2) Section 3.6. At what depth to surface is there a risk of an SSE igniting a surface fire? If the SSE is able to migrate vertically it seems that there may be a potential for an SSE to ignite surface material.

3) Section 3.6. Last sentence - recommend including a reference to the section of the report where the quantitative evaluation for the No Action Alternative is included.

4) Section 3.6.1. Descriptions of locations of heat generating material are provided in Paragraph 3; however, it is difficult to follow the description. Recommend including a figure to help show/clarify the information trying to be conveyed.

5) Section 3.6.1. Para 5, 4th sentence. Inclusion of boring log cross sections with nearby temperature probe data on a figure would help clarify this information and prevent the reader from having to dig through past reports submitted to EPA and reports submitted to MDNR to confirm the information presented. Additionally, current boring logs from the most recent sampling event where additional RIM was found would be beneficial as well.

6) Section 3.6.1. Last paragraph - overall claim that it is highly unlikely that the SSE could migrate laterally - recommend that all the data cited to support this claim be provided with this report and clearly identified.

7) Section 3.6.1. Para 4, last sentence - Approximately how many other sites indicate no pyrolysis occurs in waste depths of less than 60 feet? Refer to section 4.7, advantages bullet 4, which states alignment 1 offers the lowest potential for a SSE to original on the north side of the barrier because the alignment is located along the northern boundary of the North Quarry area. Recommend consideration that the bullet language be changed to state that it offers the lowest potential for a SSE due to the alignment and the thickness of waste being less than 60 feet.

8) Section 3.6.1, 3rd Paragraph. The 10th line states that materials below the 360 to 380 elevation are undergoing heat loss. Para states that 360 to 380 may be the depth of reactive wastes or may reflect "thermal restraints". Has the elevation of the groundwater level in this part of the quarry been considered? Is it such that the groundwater level is serving as a "thermal restraint"?

9) Section 3.6.1, 3rd Paragraph. The final sentence in this paragraph states that a similar pattern of heat dissipation is seen as the elevation in the landfill approaches the ground surface. The on-going studies/data that support this assertion and others made within this report should be included in this report as an attachment so the assertions can be easily verified without having to search through multiple reports to find supporting data.

10) Section 3.6.1, 4th Paragraph. This paragraph builds on the assertions of the previous paragraph stating that significant reduction of waste thickness in the north section of the north quarry will increase heat dissipation and expressed doubt that any significant pyrolysis would occur in wastes of such a shallow thickness. The paragraph asserts that this is consistent with observed behaviors of other sites with waste thickness less than 60-feet. Please provide references of the cited landfill SSEs to facilitate review of the referenced performance.

11) Section 3.6.1, Pg 7, 3rd Paragraph. How is the 25 times greater heat dissipation in Area 1 over that of the South Quarry determined?

12) Section 3.6.1, Pg 7, 3rd Paragraph. The statement that "no pyrolysis in waste depths of less than 60-feet should be supported by literature and/or example sites.

13) Section 3.6.1, Pg 8, 1st Paragraph. It would be helpful to provide a figure (cross section) illustrating what is being described in this paragraph.

14) Section 3.6.1, Page 7. Typo in second paragraph "... indicating they these materials..."

15) Section 3.6.2. It would assist in evaluation to provide updated figures defining the perimeter of Area 1. Figure 4-14 from the RI shows the locations where flux sampling was conducted. Locations 105, 107, 110, 120, 121, 122, 123 and 124 appear to be outside of the defined Area 1 boundary and their use in determining average flux activity may bias the actual flux from Area 1 low, though Location 105 does appear to have elevated Ra-226.

16) Section 3.6.2. Is Subpart T (Disposal of Uranium Mill Tailings) the cited NESHAP requirement? St. Louis FUSRAP has evaluated radon releases against the 40 CFR 192.02 (b) alternate criteria of 0.5 pCi/L, which may be also be an appropriate criteria to evaluate if UMTRCA is an ARAR. This would be better criteria to evaluate what exposure there may be to members of the public, if any. Models such as CAP88, AERMOD, or RESRAD-Offsite may be helpful to demonstrate a lack of current exposure, or monitoring data taken downwind from the facility could be discussed.

17) Section 3.6.2. It may be helpful to note here that additional radon generation may also be present in effluent releases from the gas collection system and not solely through radon emanation from the surface as discussed in Section 4.4 of Appendix A.

18) Section 3.6.2. Bullets - there were a total of 7 conclusions in EMSI's report. 5 of those conclusions appear to relate to potential impacts if an SSE were to occur of the SSE that, at a minimum, should be addressed as part of a no action consideration. This report

addresses only 3 of the 5 bullets. Recommend including and addressing bullet 4 from EMSI's report: "An SSE in West Lake Area 1 or 2 would create no long-term additional risks to people or the environment." and bullet 5 from EMSI's report: "Any short-term risks would be associated with the temporary increase in radon gas coming from the surface of the landfill if no cap is installed on the landfill, or if the cap called for by the 2008 ROD was not properly maintained."

19) Section 3.6.2. Para 4. the Flux calculations in Attachment A are compared with surface radiation measurements from the EMSI RI report in 2000. Recommend including that surface measurements will be taken to confirm calculated concentrations prior to selection of any no-action approach.

20) Section 2.6.2. Para 6. states that "even if these conditions were to occur, the radon emission rate form Area 1 could still be less than the standard...." then in the last sentence of the paragraph states the magnitude of radon emissions would still be less than the establishes standard...." The use of these two words seems contradictory.

21) Section 3.6.2, p 9, 3rd Paragraph. The discussion regarding leachate generation rates is appears inconsistent with the June 2013 Contingency Plan which states, "Heating of waste which results in steam/water vapor front moving out, up, and away from the SSE, which then condenses in the cooler surrounding waste mass and gas extraction well resulting in higher localized leachate generation." Please clarify.

22) Section 3.7, Pg 12, 4th bullet. This bullet appears redundant. Recommend removing.

23) Section 3.7. A no action alternative would still require additional monitoring to observe whether modeled radon flux corresponds to actual radon flux in the event an SSE migrates to/occurs in Area 1.

24) Attachment 1, section 2.2. The RI states that the 95% UCL of the mean for surface radium is 581 pCi/g. Because shallow/surface material will contribute more to radon flux than subsurface material, it seems like an additional surface layer should be added to the RAECOM model.

25) Attachment 1, section 2.2. Though the reviewer agrees that the average flux calculated over Area 1 is 13 pCi/m^2/s and below the 20 pCi/m^2/s standard, Area 1 seems very heterogeneous, with only 1 measurement the same order of magnitude as 13 (location WL-106 at 22.3) Most flux measurements are well below this, but measurements exist ranging from 0 to as high as 246 pCi/m^2/s. Given that sample data and flux data is available for most locations it may be helpful to run the model for each location where surface flux and surface/subsurface sample data is available to determine how well the RAECOM model compares to actual site data.

26) Attachment 1, section 2.2. It would be helpful to justify the use of 0.2 as the radon emanation fraction, as the RAECOM online instructions recommend a value between 0.2 - 0.3 and 0.2 is the low end of this value. The RESRAD default value is 0.25, which may be more appropriate.

27) Attachment 1, section 2.2. This analysis seems to imply an SSE is impacting the top 1.7 m of soil. At what point would risk transition from increased radon release from subsurface soil to release from a surface fire? If an SSE encounters material in the top 6' of soil it seems like ignition of surface material may pose a larger risk than increased radon production. A surface fire could potentially pose greater risk than a SSE (ie. dust kicked up with Th or U).

28) Attachment 1, section 2.2. Is the cited gas temperature increase to 80º C consistent with current observations of the SSE and assumptions used for the design and evaluation of alternatives? Discussion above (Section 6.1) seems to suggest 200ºF (~90º C) is a design consideration?

29) Attachment 1, section 2.2. Area 1 should be better defined on a drawing (similar to Figure 4-14 of the RI) to ensure that "clean" flux measurements are not inadvertently included, see comment #16

30) Attachment 1, section 4.5. Though a comparison to 10 CFR 20 may be helpful in the absence of other regulatory criteria, it should be noted that 10 CFR 20 effluent releases generally apply only to releases from an NRC licensee and may not be applicable at a CERCLA site. The effluent concentrations listed in Table 2 correspond to a public total dose of 50 millirem/year, which is above those generally allowed by EPA at CERCLA Sites. Recommend you don't compare to 10 CFR 20 since EHA has a more stringent standard.

31) Attachment 1, section 4.5. Suggest removal of the last paragraph of Section 4.5 as the release of radon into the air from stack release is not directly comparable to radon present in soil gas.

32) Attachment 1, section 4.5. 10 CFR 20 Appendix B Table 2 contains two values for radon, one for radon in 100% equilibrium and one for radon without daughters. Suggest a clarification that radon effluent releases are being compared to the 0.1 pCi/L criteria that assumes all daughters are present in equilibrium, or provide a discussion of measured/assumed equilibrium factor.

33) Section 4.0. The analyses of Options 1 and 3 generally agree with the analyses completed by USACE and provided to the EPA in the "Isolation Barrier Alignment Alternatives Assessment" dated 25 August 2014.

34) Sections 4.0 and 6.0. The eastern limits of the Option 1 & 3 alignments shown on Drawing 002 appear to violate the location of the North Quarry wall shown on Figure 2 of Part I of the Bridgeton Landfill Contingency Plan. Please verify that the proposed alignment does not violate the quarry wall and indeed meets the assumed 45-degree offset.

35) Sections 4.2 and 6.2. The excavation volumes are based on a 60-foot wide working platform which will be wide enough to accommodate the slurry trench excavating machinery and tooling. But the typical section of the slurry trench cutoff wall shown in Dwg 16 locates the wall at the center of the 60-foot wide platform. The plan view of

Alignment 1 with the Waste Cut areas shown on Dwg 003 clearly shows the alignment assumed to be at the centerline of the work platform. But to accommodate the excavating machinery, the excavated trench will need to be much nearer one of the edges of the work platform. Given that the alignment is fixed based on occurrence and non-occurrence of RIM in the foundations, and the alignment must be near the edge of the working platform, the excavation plan must be shifted laterally up to 20-feet. Similar issue with Alignment 3.

36) Section 4.2, Pg 13, 1st Paragraph. A construction platform of 45-ft was originally discussed. A comment was made on the Pre-construction work plan, section 2.1 that asked you to ensure that the proposed 45-ft wide excavation is enough to allow access for support vehicles. Is the additional 15 feet required for support vehicles? If so, please clarify what this width accommodates and how the equipment will be configured such that 60' is required.

37) Section 4.2, Pg 13, 1st Paragraph. Based on a review of the cross sections and a comparison to Option 3 (where there is substantial change of elevation along the length of the wall), it appears that a working platform could be constructed for Option 1 with much lower pre-excavation volumes. This would result in a slightly deeper wall but may be a good tradeoff due to odor and bird mitigation issues.

38) Section 4.2, Page 14, top Paragraph. This indicates the barrier volume is 5,000 bcy, however sheet 003 indicates the barrier volume is 7,500 bcy.

39) Sections 4.3 and 6.3. The 10th line states that trench construction "using slurry would require slurry decanting/liquid". Slurry trench construction requires large volumes of slurry (typically soil-bentonite slurry) to provide trench wall support during trench excavation. When completed this slurry is typically processed to remove as much of the soil solids that are suspended in order to reduce the volume of slurry liquids that must be properly disposed of. A 10-foot wide, 3-foot thick, and 40-foot deep panel will need 1,200 cu-ft (8,970 gallons) of slurry. In this case, if a particular trench panel encounters RIM during its excavation, how will the slurry be disposed of? How you intend to address the slurry should be included in Section 4.1 or 4.2 (and 6.1 or 6.2) as it is waste that will be required to be disposed.

40) Sections 4.3 and 6.3. USACE has studied the 3-dimensional global stability of earthen levees assuming discrete panels excavated near the levee toe. This analysis is completed using FLAC-3D. Depending on the geotechnical parameters of the various fills/wastes encountered in the trench and remaining in the adjacent excavated slopes, longer panels may be safely used thereby shortening the construction times. To complete this analysis, detailed geotechnical exploration incorporating in-situ measurements of shear modulus with pressure meter must be completed. Recognize that this is a design issue to be addressed later; however, it can impact the quoted schedule.

41) Section 4.3, Pg 14, 1st Paragraph. Recommend changing "reaction" to "SSE".

42) Section 4.3, Pg 14, 1st Paragraph. Recommend expanding on the limitation associated with storm water management.

43) Section 4.3, Pg 14, 1st Paragraph. The design timeframe (103 wks) has increased substantially over what had been previously discussed. Based on a review of the schedule there appears that there are places where durations could be reduced. For example, investigations could begin prior to completion of the heat extraction study.

44) Section 4.3. Last Paragraph. EPA will have to make determination on requirement regarding the need to test waste above the 1975 topographic surface. This is a landfill and although there may not be RIM above the 1975 topographic surface, there may be other constituents of concern and testing may be warranted.

45) Section 4.6. Recommend that laboratory data and boring logs from last sampling event be provided along with an updated dwg of currently know extent of contamination and information regarding vertical distribution of contamination if the information is to be relied upon for this report to back up a no action response. Recommend including a dwg showing estimated 1975 topographic surface and 1975 aerial photographs upon which this estimated surface is based. Would need to include that information that is being relied upon in this report to support the no action option.

46) Section 4.6. Para 2 - recommend the specific section in Attachment A that contains the info being referenced in this text be added within the parentheses so it is easy for reader to locate the information.

47) Section 4.7, Pg 17, 6th bullet. Although there is a caveat later in the document regarding acceptability of leaving excavated RIM waste on-site, that is far from certain so recommend not listing it as an advantage.

48) Section 4.7. It would be helpful in evaluating alternatives if an estimate of the potential amount of RIM to be excavated was discussed.

49) Section 4.7. The extent of RIM has not yet been determined. Recommend author considers qualifying the language in the first paragraph by indicating that the statements are based upon data collected to date and that the extent of RIM has not yet been determined.

50) Section 4.7. Report states, "Radon emissions from the RIM material located outside of the barrier would not result in an exceedance of the Radon NESHAP." Because the extent of RIM has not yet been identified and because of the heterogeneity of the waste placement, recommend that this text be revised to allow for this consideration.

51) Section 4.7. Disadvantages - can non-rad waste removed as a result of barrier installation be placed back in the landfill? If this has not yet been determined, then it is recommended that it be captured as a disadvantage because there is a possibility that it would not be approved. If not approved, it would significantly impact the construction duration.

52) Attachment B, para 1.1.2. Another opportunity to provide clarity to the design would be to assume that the "maintenance" of the wall would include re-adjustment of the top of fill elevation on the "hot-side" of the wall. As the pyrolysis induced settlement (accelerated settlement due to consumption of waste materials due to SSE) occurs, the ground surface on the "hot side" of the wall could be raised to limit the difference in ground surface between the "hot side" and "cold side" of the wall. Use of careful compaction techniques (from just spreading fill to fully compacting the fill) could keep the in-place unit weight of the fill to within acceptable levels to equalize the geostatic horizontal stress placed on both sides of the wall.

53) Attachment B, para 1.1.2. The first paragraph states that it has been determined that anchoring the NCE into the alluvium/bedrock is not feasible. Dwg 004 shows the Option 1 NCE proposed to extend down to elevations 420 to 430. Cross section AA in Figure 2 of Part I of the Bridgeton Landfill Contingency Plan shows bottom of wastes or top of bedrock at/around elevation 425 under OU-1 Area 1. It seems that the top of rock may be quite close and if so, anchoring the NCE into the bedrock may not be as infeasible as first thought. Use of hydro mill technology to key into the bedrock is a common technique. Keying into bedrock will provide clarity on the fixity of the bottom of the NCE.

54) Attachment B, para 1.1.2. Perhaps the responsible party should consider a limited application of the heat extraction technology installed on the "hot-side" of the wall. If successful, it could limit the temperature applied to the concrete surface and thereby limit the heat induced stresses/strains.

55) Attachment B, para 1.1.3. See comment #42 concerning 3 dimensional slope stability using FLAC-3D.

56) Attachment B, para 1.1.3. A monitoring system will also include surveys of the ground surface adjacent to both sides of the wall. Also, replaceable temperature gages should be installed in the wall interior. Given the proposed life span of the wall, the temperature gages would have to be accessible for maintenance and replacement as necessary. Also some kind of telltale extending to the base of the wall to determine its elevation (if not embedded into bedrock) should be considered. It is recognize this is a design consideration and would be addressed during design.

57) Section 6.2, Pg 22, 1st Paragraph. Recommend explaining why a barrier width of 5.0-ft was assumed versus the 3.0-ft width of Option 1. It is assumed this is for structural considerations due to the greater depth of the wall.

58) Section 6.2, Pg 22, 1st Paragraph. Sheet 010 indicates a barrier volume of 7,500 bcy for Option 3 as opposed to the 11,000 bcy sited here in the text.

59) Section 6.7, Pg 25, 2nd bullet. Recommend not listing the potential to leave excavated RIM waste on-site as an advantage.

60) Section 6.7. The extent of RIM has not yet been determined. Recommend author considers qualifying the language in the first paragraph by indicating that the statements are based upon data collected to date and that the extent of RIM has not yet been determined.

61) Section 7. It is stated that for Option 4, the heat extraction points would be installed such that depths of the extraction points would be relatively shallow. Does this shallow installation still include installation down to the bedrock as indicated in drawing sheet 16?

62) Section 7.1. It is stated for Option 4, that the cooler would consist of an adiabatic air cooler installed with a closed loop liquid circulation system. While Attachment C., Heat Extraction Barrier Design Memorandum, describes a close circuit cooling tower. Please verify that a close circuit cooling tower is the current design concept.

63) Section 7.1. The limiting criteria for any barrier system would be to maintain the waste on the north side of the barrier at an average temperature of 175 degrees Fahrenheit. What is the best guess for the entering and leaving temperatures of the cooling liquid at this time?

64) Section 7.1. The heat extraction points would be driven in place vs. drilling a well. What is the typical depth that the pipe can be driven into place? What is the depth of the bedrock at the proposed locations? What is the possibility of success with this method of installation?

65) Section 7.6. Para 2. Potential RIM outside the barrier is not expected to pose a significant risk (see attachment A) and RIM outside barrier would not result in exceedance of Radon NESHAP. Recommend the specific section in Attachment A in which the information that supports this can be found is cited in the parentheses.

66) Section 7.7. It is stated for Option 4, that "The RIM material that would remain outside of the barrier wall is currently covered by 25 to 50 of solid waste and a landfill cover that prevents direct contact with the RIM and provides shielding from gamma radiation." Recommend units of measurement be inserted (ie. "...25 to 50 'feet' of solid waste...").

67) Section 7.7. It is stated for Option 4, that "Installation of heat extraction points is a common technology used for geothermal energy development and therefore this alternative is technically feasible." However, it comes down to the numbers. How do the proposed conceptual design conditions compare to the design conditions for a typical system that comprises this common technology? Do geothermal systems exist that have design conditions that are in the same neighborhood of the conditions that will exist within the SSE?

68) Attachment C, Section 1.1. It is stated that "The primary data parameters recorded…" from the single well, GIW-4, "…were the inflow and outflow water temperatures, flow rate and the temperature within the casing as measured by thermocouples at multiple depths. Where is that data, specifically the water flow rates and the entering and leaving water temperatures? Recommend that data be included in the report to as an attachment to support the claim of feasibility.

69) Attachment C, Section 1.3. It is stated that "Estimates of the maximum heat flux in the south quarry have been in the range of 14 Watts/sqm, as of July 2013." This rate is very low. This rate is slightly less than 5 Btuh/sqft, which, as a comparison, would not fully heat a typical building to typical occupied conditions in the warmest areas of this country. Over what area is this rate determined? What is the total heat to be rejected by the system?

70) Attachment C, Section 2.2. It is stated that the vertical heat extraction elements be comprised of corrosion resistant metal (low carbon stainless steel) or nonmetallic materials. Metallic materials underground may required cathodic protection while temperature limitations maybe an issue for nonmetallic materials. It is recognized that this is a design issue that will need to be considered during design.

71) Attachment C, Section 2.3. Please confirm that the proposed design delta temperatures for a cooling tower powered system are 175 degrees F minus 85 degrees F or 90 degrees F.

72) Attachment C, Section 2.3. Please confirm that the proposed design delta temperatures for a chiller powered system are 175 degrees F minus 40 degrees F or 135 degrees F.

73) Attachment C, Section 2.3. It is stated that "These systems will be above ground HDPE pipe with flex connections to the extraction points." Typically, we only see HDPE pipe installed below grade due to issues with UV. How will this be addressed? It is recognized that this is a design issue that will need to be considered during design.

74) Attachment C – General. The issue with utilizing typical HVAC machines in this situation is that the equipment pretty much does what it was designed to do, which is not a delta temperature of 90 to 135 degrees F. Specifically, vapor compression chillers typically will not produce a delta temperature above 20 degrees F and will shut down on a safety if entering water temperatures become too extreme. With a flowing fluid, do you intend to use equipment in series to achieve the necessary temperature differential? Do you know of a specific chiller that is capable of these high temperature drops?

75) Attachment C, Pg 3, 2nd Bullet. Why was a point of compliance of 15-ft north of the cooling elements selected for Option 4?

76) Drawing 16. The Option 1 and 3 Typical Inert Barrier shows the barrier centerline located in the center of the flat work area. To accommodate the heavy excavation machinery and tooling, the Inert Barrier must be located approximately 45 to 50 feet away from either edge. USACE studies of slope stability show that better global stability factors of safety are obtained when the heavy excavation machinery and tooling is located on the side of the trench opposite the taller excavated slope.

77) All Drawings. All drawings show historical boundaries. Recommend these drawings be updated to reflect current contaminant boundaries with a dashed line where the extent of contamination has not been determined.

78) Drawings 002 and 009. The eastern limits of the Option 1 and Option 2 alignments shown on Drawings 002 and 009 appears to violate the location of the North Quarry wall shown on Figure 2 of Part I of the Bridgeton Landfill Contingency Plan. Please verify that the proposed alignments do not violate the quarry wall and indeed meets the assumed 45-degree offset.

79) Drawings 003 and 010. Each of these drawings include values of pre-excavation and barrier excavation volume. Recommend also showing the overall volume needing to be relocated.

80) Sections 3.5, 3.6, 3.7, 4.5, 4.6, 4.7, 5.0, 6.5, 6.6, 6.7, 7.4, 7.5, 7.6, 7.7, and Attachment D. There is still no Bird Monitoring and Control Plan to review. The sections reviewed considered the concerns of the St Louis Airport Authority and consistently assessed the concerns of quantity of waste and duration of exposure and the impacts those two things have on Bird Airstrike concerns. A new Alternative, Heat Extraction Barrier, was introduced that has less bird airstrike implications than the other options. There was not much emphasis placed either on covering excavated waste or in handling and transport of waste for installation of the isolation barrier. This should be covered in the forthcoming Bird Monitoring and Control Plan.